Ordering number: EN 1161D

Monolithic Linear IC

No. 1161D

SANYO

LA4510

240mW AF Power Amplifier

Applications

- Especially suited for use in 3V micro cassette recorder, mini cassette recorder, headphone stereo applications.

Features

- Operating supply voltage range : 2 to 5V
- Low current dissipation (7mA typ/V_{CC}=3V)
- Output power : 240mW typ at V_{CC}=3V, R_L=4ohms, THD=10%
  40mW typ at V_{CC}=3V, R_L=32ohms, THD=10%
- Built-in muting circuit to be operated at the time of power switch ON capable of varying starting time and making pop noise low.
- Soft clipping

Maximum Ratings at T_a=25°C

			unit
Maximum Supply Voltage	V_{CC}max	6.0	V
Maximum Output Current	$I_O$peak	570	mA
Allowable Power Dissipation	$P_d$max	700	mW
Operating Temperature	Topr	-10 to +60	°C
Storage Temperature	Tstg	-55 to +150	°C

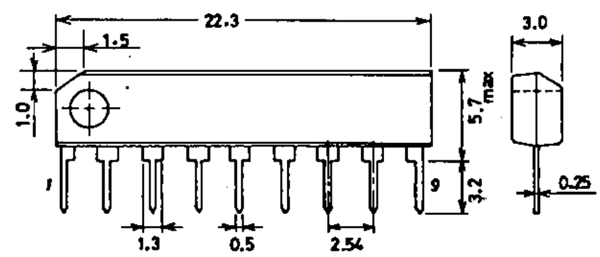
Operating Conditions at Ta=25°C

Recommended Supply Voltage	V_{CC}	3.0	4.5	V
Load Resistance	R_L	4 to 32	8 to 32	ohm

Electrical Characteristics at T_a=25°C, V_{CC}=3.0V, R_L=4ohms, f=1kHz, See Sample Application circuit 1.

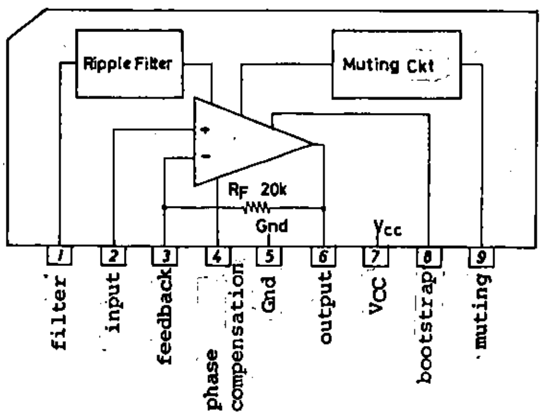
			min	typ	max	unit
Quiescent Current	$I_{cco}(1)$	No signal		7	12	mA
	$I_{cco}(2)$	No signal, V_{CC}=4.5V		8.5	15	mA
Voltage Gain	VG	R_1=100ohm	42	45	48	dB
Output Power	P_O	THD=10%	200	240		mW
Total Harmonic Distortion	THD	P_O=100mW		0.4	1.5	%
Output Noise Voltage	V_{NO}	Rg=1kohm, BW=20Hz to 20kHz		0.2	0.5	mV
Output Ripple Voltage	V_{rp}	Rg=0, f_R=100Hz, V_R=50mV		0.7		mV

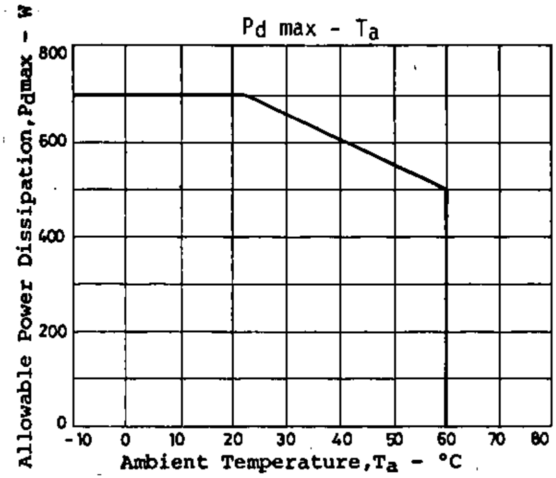
Package Dimensions 3017B
(unit : mm)



SANYO Electric Co., Ltd. Semiconductor Business Headquarters
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110 JAPAN

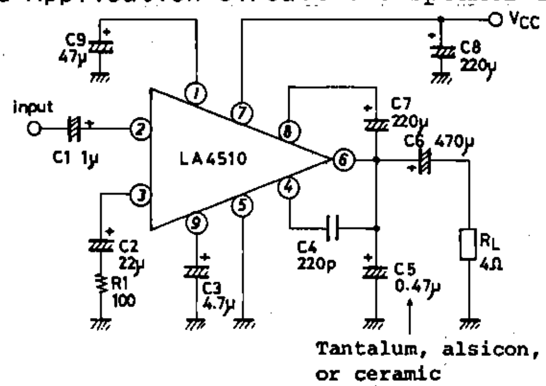
Equivalent Circuit Block Diagram

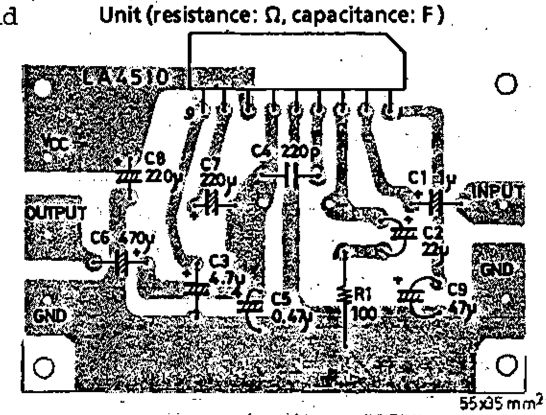




Sample Application Circuit 1 : Speaker load

Unit (resistance: Ω, capacitance: F)





Sample printed circuit pattern (Cu-foiled area)

1. Description of external parts

C1(1uF) . Input capacitor (Coupling capacitor for input signal)
Decreasing the capacitance value lowers the frequency response at low frequencies.

C2(22uF) . Feedback capacitor (Bypass of feedback signal)
Decreasing the capacitance value lowers the frequency response at low frequencies; increasing the capacitance value makes the starting time later.

C3(4.7uF) . Muting capacitor
Decreasing the capacitance value makes the starting time earlier; removing C3 causes pop noise. Increasing the capacitance value makes the starting time later.

C4(220pF) . Phase compensation capacitor (Phase compensation by local feedback)
Decreasing the capacitance value causes the frequency response to extend at high frequencies, and thereby oscillation is liable to occur. Increasing the capacitance value worsens distortion factor at high frequencies.

C5(0.47uF) . Oscillation blocking capacitor
Decreasing the capacitance value causes oscillation to liable to occur. Using an ordinary electrolytic capacitor may cause oscillation to occur at a low temperature. Use a tantalum or alsicon electrolytic capacitor that is good in temperature characteristic.

C6(470uF) . Output capacitor (Cutoff of DC to speaker)
Decreasing the capacitance value causes insufficient power at low frequencies.

C7(220uF) . Bootstrap capacitor (Feedback from output stage)
Decreasing the capacitance value causes insufficient power at low frequencies, especially when voltage is reduced.

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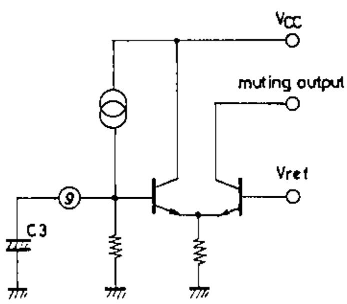
C8(220uF) . Power capacitor (Drop in power impedance)
Decreasing the capacitance value causes motor noise, etc. to be entered easily. Removing C8 may cause oscillation to occur.

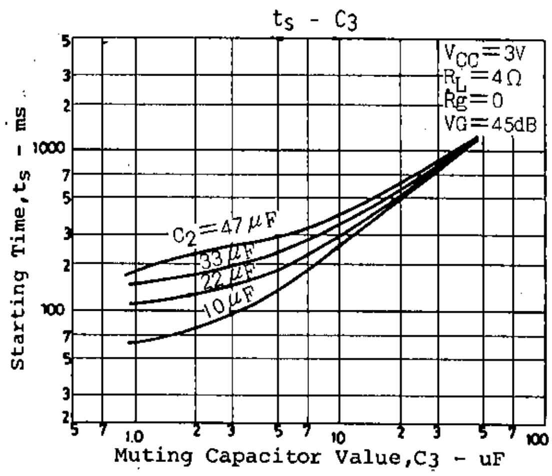
C9(47uF) . Capacitor for ripple filter (Filter for bias voltage)
Decreasing the capacitance value causes the circuit to be subjected to the influence of power supply, and thereby ripple is liable to occur.

r_i(100ohms) . Feedback resistor (Setting of voltage gain)
Decreasing the resistance value increases voltage gain, but worsens distortion factor, and thereby gain varies. Increasing the resistance value causes oscillation to liable to occur.

2. Setting of starting time

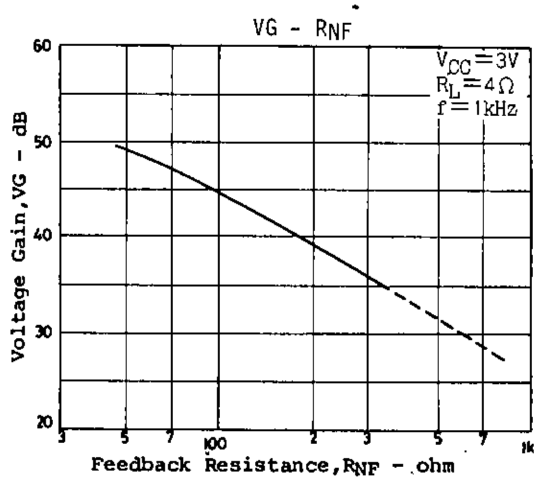
The LA4510 contains a muting circuit to be operated at the time of power switch ON/OFF. Thus, pop noise coming from power amplifier and preamplifier is rejected. The starting time depends on the capacitance value of feedback capacitor C2 as well as muting capacitor (C3).





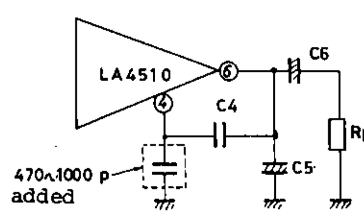
3. Voltage Gain

Voltage gain depends on the ratio of internal resistance value (20kohms) to external resistance value (Rl). However, since setting of open loop voltage gain is a little on the low side (62dB) due to soft clipping, it is not recommendable to use the IC at a voltage gain greater than recommended. If the IC is used at a voltage gain less than recommended, take care not to cause oscillation to occur.



4. Action to prevent oscillation

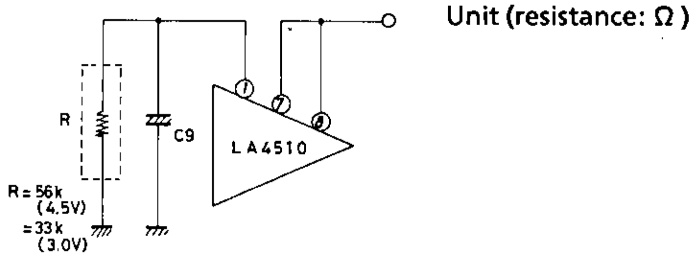
If oscillation occurs, check C5. The larger the capacitance value is or the smaller the value of tan δ is if the capacitance value is the same, C5 acts more effectively against oscillation. Using an electrolytic capacitor as C5 may cause oscillation to occur at a low temperature.



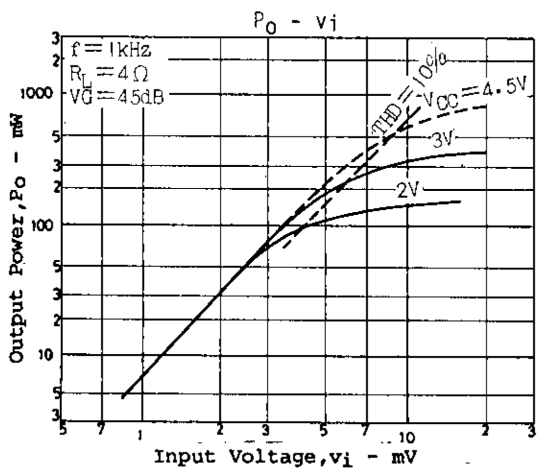
It is recommendable to use a tantalum or alsicon electrolytic capacitor that is good in temperature characteristic. For oscillation that occurs at a decreased voltage gain, increase the capacitance value of C4. If it is impossible for C4, C5 to act effectively against oscillation, add a ceramic capacitor of 470 to 1000pF across pin (4) and GND. In this case, distortion factor at high frequencies worsens to some extent.

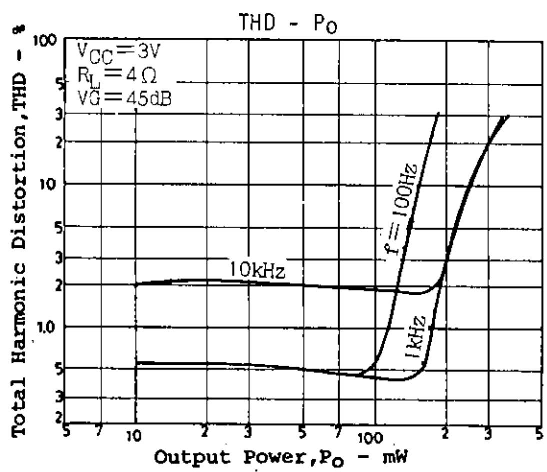
5. Removal of bootstrap capacitor

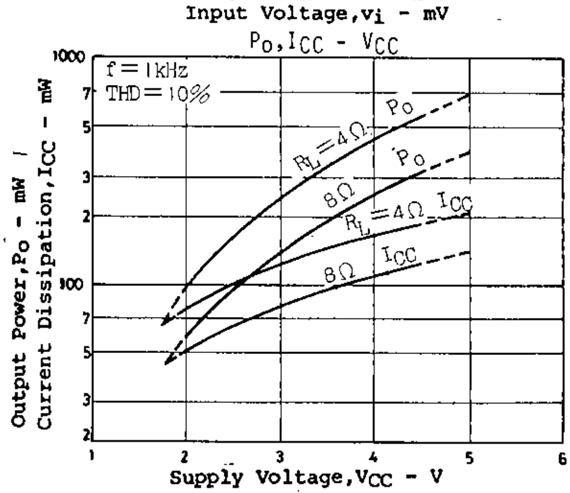
In applications where more power than required is available (approximately 60% of rating), it is possible to remove bootstrap capacitor C7 (pin (7)-to-pin (8) short). However, since this causes clipping unbalance to occur, this unbalance must be compensated by use of a resistor and a diode. A simple compensation method is shown below. This method makes it possible to attain clipping balance at a certain supply voltage only.

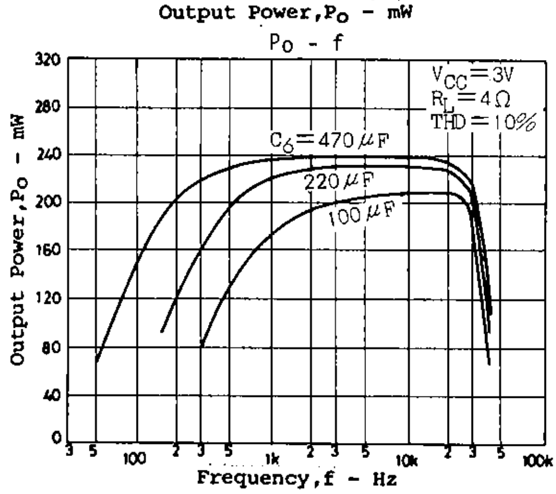


Unbalance compensation mothod

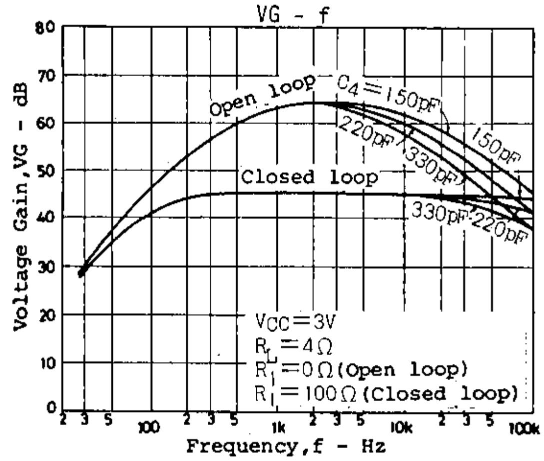




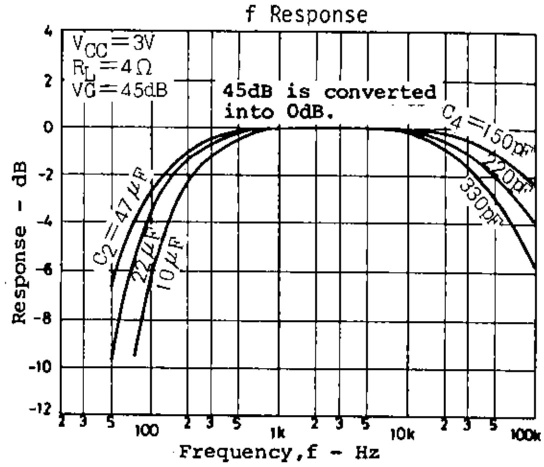




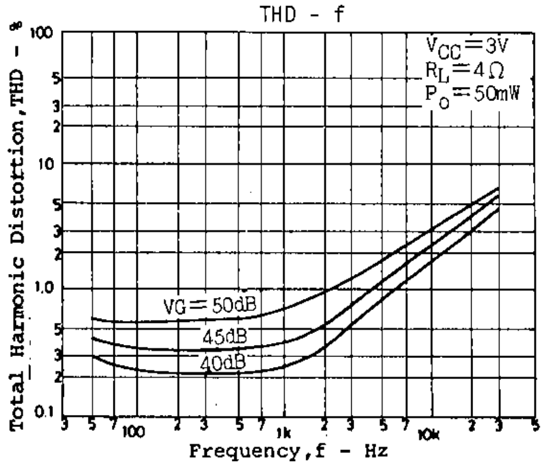
VG - f



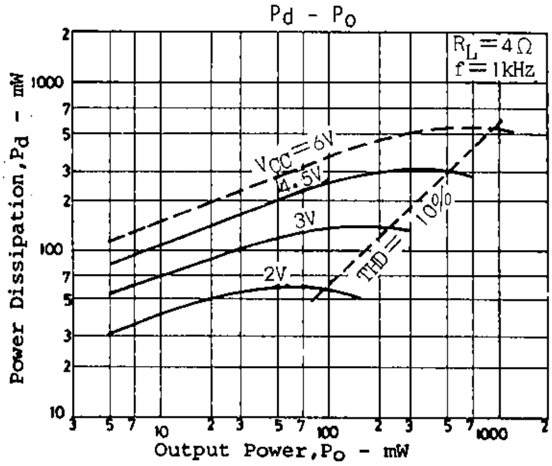
f Response



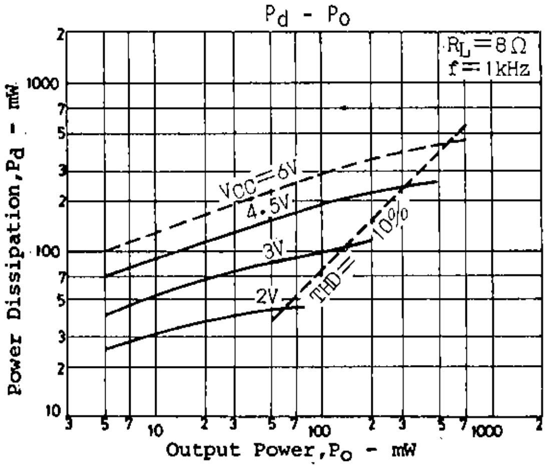
THD - f



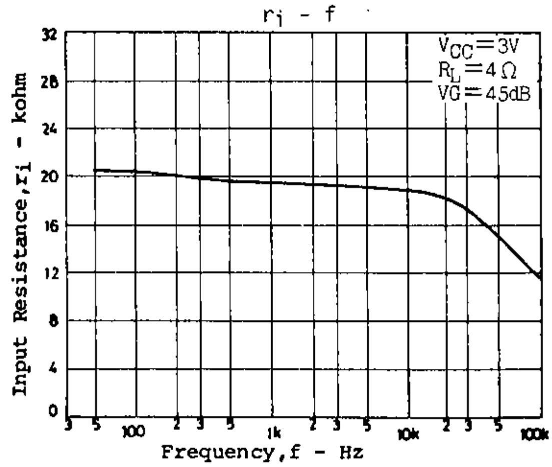
Pd - PO



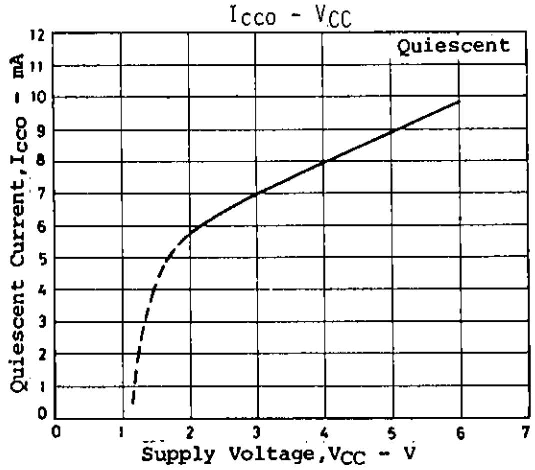
Pd - PO



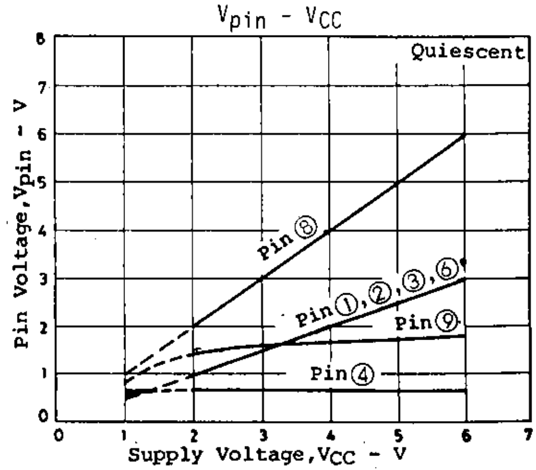
ri - f



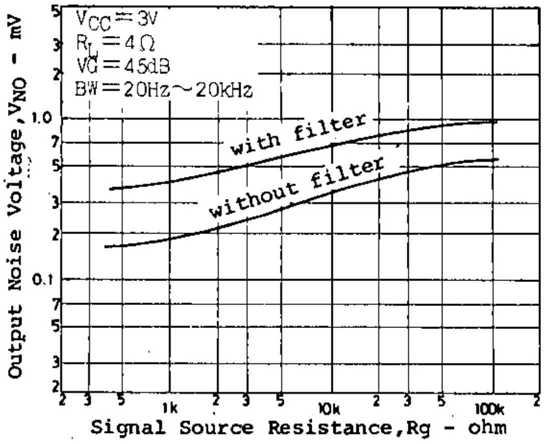
ICCO - VCC



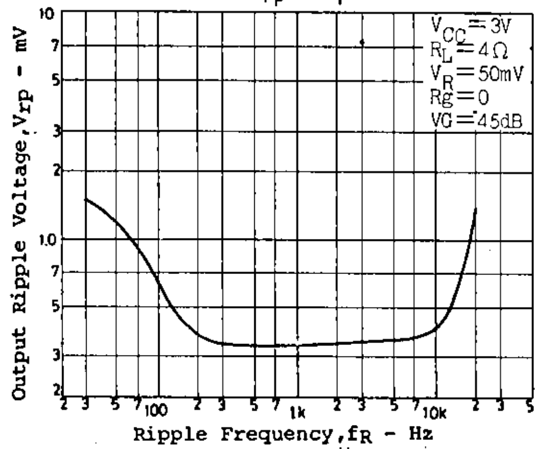
Vpin - VCC



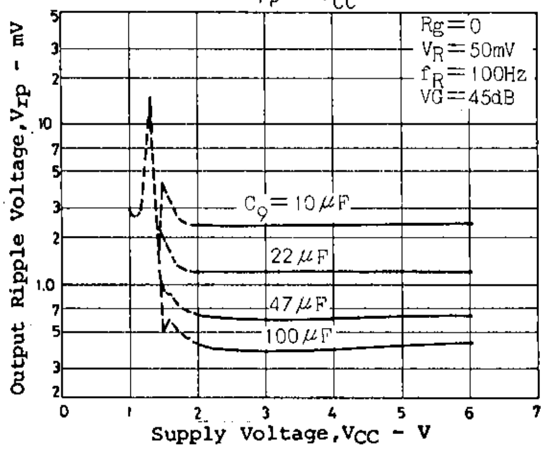
V_{NO} - Rg



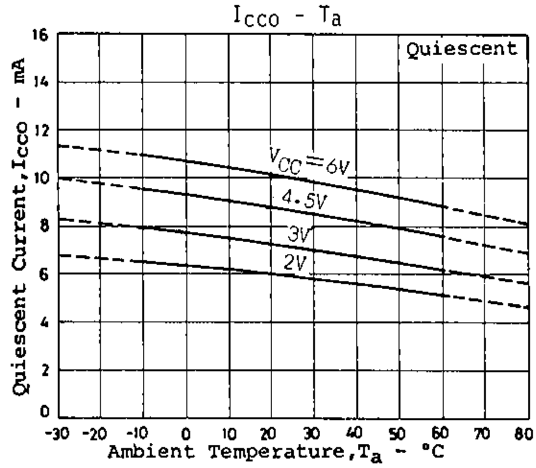
V_{rp} - f_r



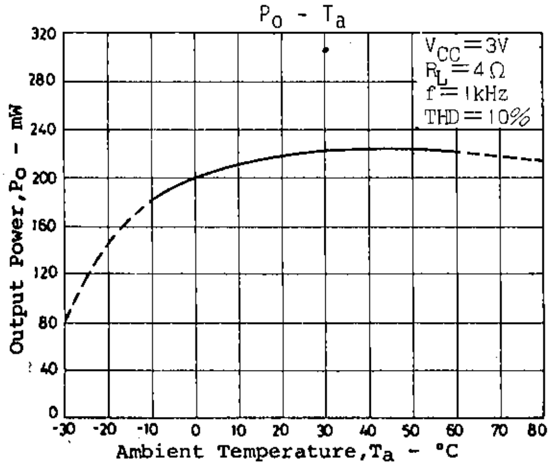
V_{rp} - V_{CC}



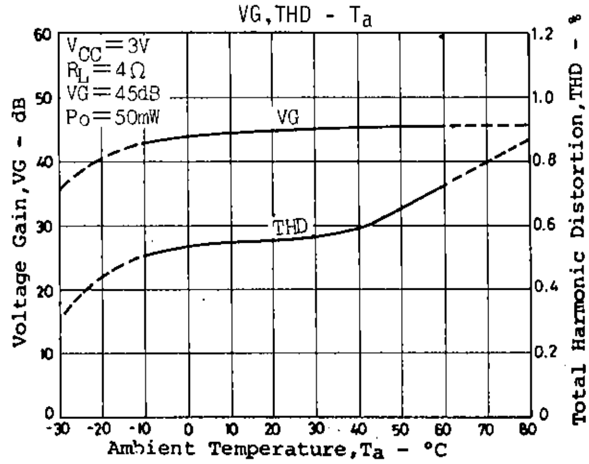
I_{cco} - T_a



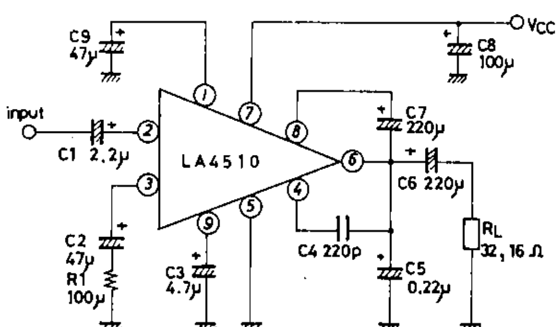
P_o - T_a



VG,THD - T_a

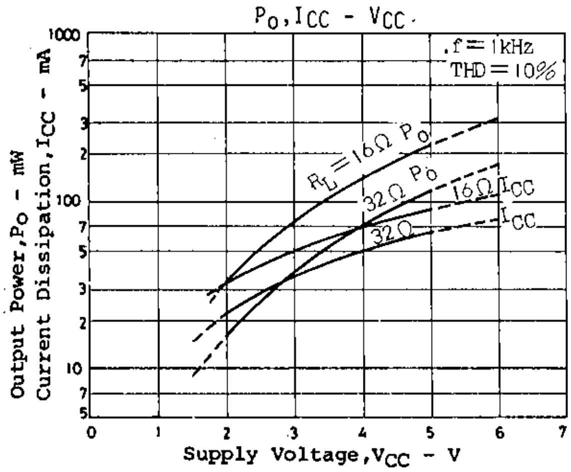


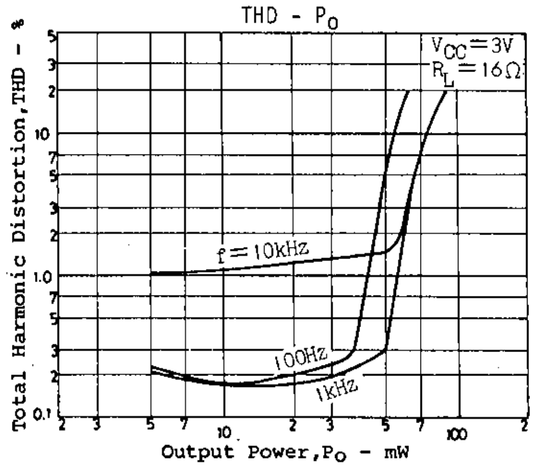
Sample Application Circuit 2 : Headphone load



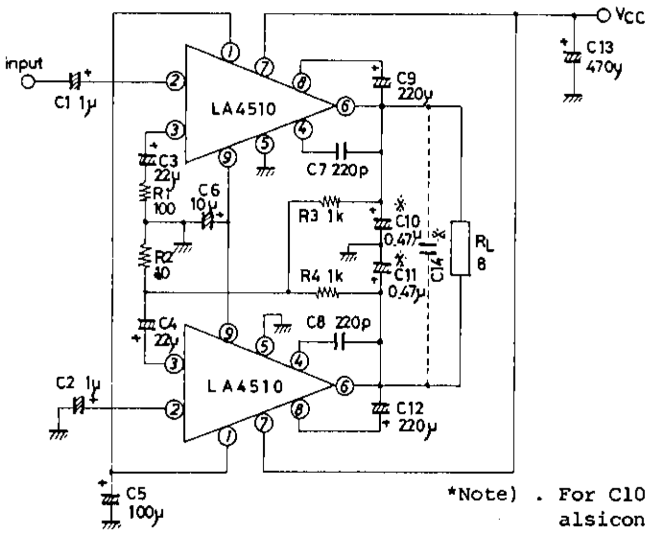
Tantalum or alsicon, ceramic

Unit (resistance: Ω, capacitance: F)



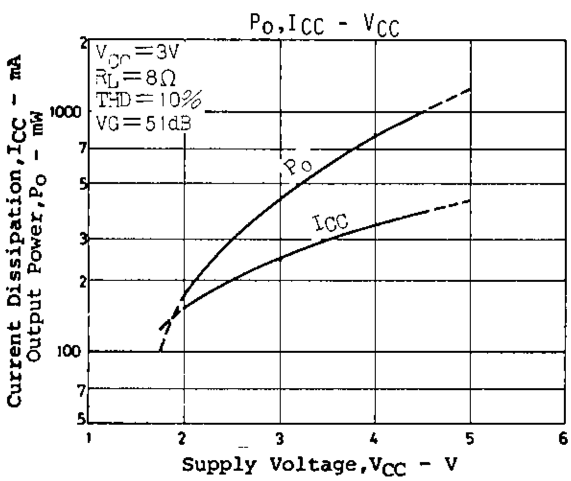


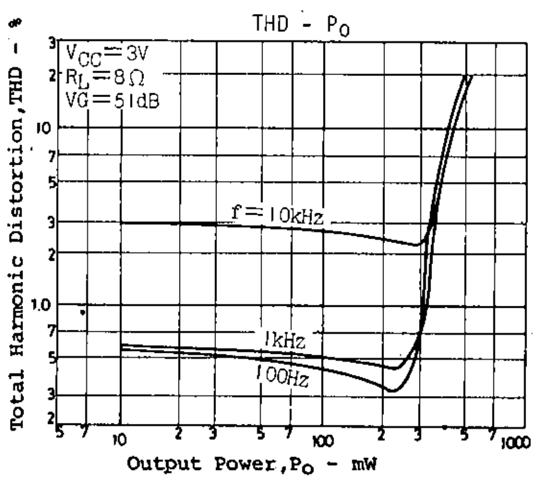
Sample Application Circuit 3 : Bridge



*Note) . For C10,C11, use tantalum or alsicon electrolytic capacitor.
. If oscillation occurs, add C14 (0.1 to 0.2u ceramic capacitor).

Unit (resistance: Ω, capacitance: F)





Proper cares in using IC

- Maximum ratings

  If the IC is used in the vicinity of the maximum ratings, even a slight variation in conditions may cause the maximum ratings to be exceeded, thereby leading to breakdown. Allow an ample margin of variation for supply voltage, etc. and use the IC in the range where the maximum ratings are not exceeded.
- Pin-to-pin short

  If power is applied when the space between pins is shorted, breakdown or deterioration may occur. When mounting the IC on the board or applying power, make sure that the space between pins is not shorted with solder, etc.
- Printed circuit pattern

  When designing the printed circuit pattern, make the power supply, output, and ground lines thick and short and arrange the pattern and parts so that no feedback loop is formed between input and output. Place power capacitor C8, oscillation blocking capacitors C4, C5 as close to IC pins as possible to prevent oscillation from occurring. Refer to the sample printed circuit pattern.